Kreano 13 (2) (2022) : 354-369
KREANO
Jurnal Matematika Kreatif-Inovatif
http://journal.unnes.ac.id/nju/index.php/kreano

Cognitive Flexibility of Students in Solving Mathematical Problems: A Phenomenology Study

Rama Nida Siregar[1]*, Didi Suryadi[1], Sufyani Prabawanto[1], Abdul Mujib[2]

[1]Department of Mathematics Education, Universitas Pendidikan Indonesia
[2]Department of Mathematics Education, Universitas Muslim Nusantara Al-Washliyah
Corresponding Author: ramanidasiregar@upi.edu*

History Article
Received: November, 2022 *Accepted: December, 2022* *Published: December, 2022*

Abstract

The importance of students' cognitive flexibility abilities in solving mathematical problems is the driving force behind this research. This study's goal was to identify and characterize students' levels of cognitive flexibility in handling mathematical problems in light of the indicators. This kind of study uses qualitative research techniques and a phenomenological design. The instrument employed is a test of problem-solving skills that has been supplemented with markers of cognitive flexibility to see the talents that have been assessed and interviews to learn more in-depth. In this study, data on students' capacities for cognitive flexibility in solving mathematical problems were collected and analyzed utilizing exams for such problem-solving and the indicators employed. Two markers of cognitive flexibility are included in this examination of mathematical problem-solving skills: (1) offering several interpretations of a picture, story, or mathematical issue, and (2) applying a variety of mathematical problem-solving techniques. According to the findings of this study, 5 participants fell into the flexible category, 6 people fell into the somewhat flexible category, and 4 participants fell into the less flexible category when it came to their ability to solve mathematical problems. The research's relevance is that future researchers and educational practitioners can attempt to construct learning to improve students' cognitive flexibility abilities in solving mathematical issues. This can be investigated in topics other than social arithmetic.

Abstrak

Latar belakang penelitian ini yaitu pentingnya kemampuan cognitive flexibility siswa dalam pemecahan masalah matematis. Penelitian ini bertujuan untuk mengetahui serta mendeskripsikan kemampuan cognitive flexibility siswa dalam pemecahan masalah matematis berdasarkan indikatornya. Jenis penelitian ini adalah desain fenomologi dengan metode kualitatif. Adapun penggunaan tes kemampuan pemecahan masalah yang telah diliputi indikaor kemampuan cognitve flexibilty untuk melihat kemampuan cognitive flexibilty yang telah diujikan dan wawancara untuk mengetahui lebih mendalam merupakan instrumen penelitian ini. Dalam penelitian ini, data diperoleh untuk melihat kemampuan cognitive flexibility siswa dalam pemecahan masalah matematis yang dianalisis menggunakan tes pemecahan masalah matematis berikut indikator nya. Tes pemecahan masalah matematis ini memuat dua indikator kemampuan cognitive flexibility yaitu: 1) memberikan berbagai penafsiran terdapat suatu gambar, cerita, atau masalah matematis; dan 2) menggunakan beragam strategi penyelesaikan masalah matematis. Kesimpulan yang diperoleh dalam penelitian ini terkait kemampuan cognitive flexibility siswa dalam pemecahan

p-ISSN: 2086-2334; e-ISSN: 2442-4218

masalah matematis sebanyak 5 partisipan berada pada kategori fleksibel, 6 partisipan berada pada kategori cukup fleksibel, dan 4 partisipan berada pada kategori kurang fleksibel. Sehingga implikasi dalam peneltian adalah agar para peneliti selanjutnya maupun praktisi pendidikan dapat berupaya mendesain pembelajaran untuk meningkatkan kemampuan cognitive flexibility siswa dalam pemecahan masalah matematis dan dapat diteliti pada materi lain selain aritmatika sosial.

***Keywords**: Cognitive flexibility; Student; Solving mathematical problems; Phenomenology study.*

INTRODUCTION

The ability to cognitive flexibility in mathematics is basically one of the demands for learning direction that is needed now and in the future, so it is important for students to have it (Damirchi et al., 2020; Hong et al., 2021; Milla-Cano & Gatica-Ferrero, 2020; Theeboom et al., 2015; J. Wang & Jou, 2020). Furthermore, educators strive for students to become someone who has cognitive flexibility, namely someone who is able to see problems from various perspectives, has various ways of solving mathematical problems, has self-efficacy, but a lot of material content makes educators generally prioritize other aspects such as understanding concepts, so that in the process of solving math problems, many students are still based on formulas, and step by step methods from guidebooks (Al-Zoubi, 2020; Chen et al., 2019), this can be seen from the experience of researchers in teaching junior high school students. This also provides smaller opportunities for students to find answers or alternative solutions that are different from what has been taught, and causes the cognitive and affective abilities of students to not be varied and maximal (Al-Zoubi, 2020; Demirtaş, 2020; Gökçen et al., 2019).

Cognitive is a thought process, namely the ability of individuals to connect, assess and consider an event or events (Jiatong et al., 2021a). Cognitive has an important role for the development of students in the present and in the future because almost everything that is done in school learning is related to cognitive (Gao et al., 2018). Students are objects that are directly related to the learning process, so that cognitive development greatly determines the success of students (Jiatong et al., 2021b). Therefore, it is not surprising that cognitive abilities are very much needed by students in current learning so that educators are also required to apply a curriculum that is able to develop students' cognitive development better, this happens because of increasing competition in the era of globalization and only people who have high cognitive abilities capable of competing in this era (R. N. Wang & Chang, 2022). Through cognitive development, students' thinking functions can be used quickly and precisely to solve a problem (Cambaz & Ünal, 2021). So it can be said that cognitive is also related to problem solving (He et al., 2022).

One of the objectives of learning mathematics at the secondary school level is to guide students to have problem solving abilities (Depdiknas, 2006). It was further stated that in the process of learning mathematics, schools have been required to involve solving mathematical problems as an integral part (NCTM, 2000). Problem solving is also the core of mathematical activity and is one of the competencies that is needed in the 21st century (von Duyke & Matusov, 2015). These in daily life, problem solving abilities are required including in the work environment and school environment (Swanson, 2015).

The goal of problem solving is to identify a solution to a problem whose solution cannot be found immediately (Schoenfeld, 1985). Therefore, some researchers emphasize that students' problem-solving abilities are important to be studied more deeply (Bosch et al., 2018; Grežo & Sarmány-Schuller, 2018; Kingsdorf & Krawec, 2016; Pratama & Setyaningrum, 2018). Moreover, problem solving is a process in which a person uses acquired knowledge, skills and understanding to meet the demands of an unknown situation (Swanson et al., 2019).

One of the key components of the mathematics curriculum, which is used not just in Indonesia but also around the world, is problem solving (Arcavi & Friedlander, 2007; Jonassen, 1997; Sweller, 1988). Sadly, the study's findings indicate that students struggle to solve math problems (Chevalier et al., 2020; Soewardini et al., 2019; Utemov et al., 2020; Wen et al., 2020). Cognitive development of students can be included in problem solving into school subjects (Kingsdorf & Krawec, 2016). In Indonesia, this cognitive ability is included in subjects, where students are strived to be able to answer questions that are required to think at a higher level, but this is very influential from human resources, namely students, and educators (Arifin et al., 2021). An educator who teaches or gives students high-level thinking questions should be able to analyze the suitability of the questions, meaning that the educator himself is able to think at a higher level, that is, has cognitive flexibility abilities.

In neuropsychology, the capacity to shift between modes of thought and adjust to novel or shifting circumstances is referred to as cognitive flexibility (Bilgic et al., 2021). The activities one takes to address current issues when presented with a dynamically changing environment are thought to result in cognitive conflict (Martinez & Dong, 2020). On the one hand, efforts are made to continue acts that aim to achieve a specific result. On the other hand, the actions taken continue to be flexible and open to potential alternatives, to abandon ineffective goals, and to adjust to changing external or internal situations (Lloyd et al., 2013; Marzecová et al., 2013; Muyan-Yılık & Demir, 2020). Therefore, given how quickly things are changing, it will take flexible thinking to address any potential issues that may arise (Chung et al., 2012; Ebersbach & Hagedorn, 2011; Martin et al., 2011).

In problem solving, students also to solve mathematical problems quickly with the various concepts they have, one needs mathematical cognitive flexibility (Martin & Anderson, 2009; Spensley & Taylor, 1999). They must be able to comprehend the issue at hand in order to find a solution (Astutiani & Isnarto, 2021; Fajri et al., 2021), consider it from different perspectives and avoid thinking rigidly in terms of a single course of action (Jones et al., n.d.). However, based on the reality on the ground that mathematical problem-solving flexibility is still lacking in kids (Gruber et al., 2010; Han et al., 2011).

It is expected that in the context of issue solving, students' cognitive flexibility will allow them to offer answers to novel challenges that differ from common solution approaches, come up with fresh solutions, and shift their previous perspective (Crosbie et al., 2009). When students are able to alter their ideas and approach problems in different ways, they are said to be cognitively flexible (Zhang et al., 2009). Cognitive flexibility is needed as one of the brain-based skills needed by humans to carry out tasks effectively and solve problems (Spensley & Taylor, 1999). Individuals who succeed in adapting are those who can be called

elastic, what is meant In the field of education, thinking flexibility is also referred to as cognitive openness or cognitive flexibility (R. N. Wang & Chang, 2022).

Several previous research studies on cognitive flexibility abilities include research on the effect this study found that there is a positive relationship between cognitive flexibility and resistance to change cognitive resistance, where employees are more able to accept organizational changes in aspects of awareness of alternatives and choices before deciding and behavioral adjustments to new situations (Renner & Beversdorf, 2010). Additionally, the study's findings indicate a connection between cognitive flexibility and problem-solving abilities. Its a correlation strength of 0.840, and cognitive flexibility contributes 70.6% to problem-solving abilities (Bilgin, 2009). Thus, cognitive flexibility influences increasing students' problem-solving abilities.

The results of previous research on the flexibility component include cognitive variety, cognitive novelty and change in cognitive framing, meaning that when students possess the capacity for flexible thought (cognitive flexibility), the ability to quickly pose a variety of challenges (cognitive variety), and the capacity to solve innovative or unexpected situations (cognitive novelty). as well as being able to change or identify in a new way (change in cognitive framing) (Hillier et al., 2006). From this description it includes novelty and elaboration in thinking (cognitive originality and cognitive elaboration) so that these components are considered the same (Gajewski et al., 2010). Furthermore, cognitive flexibility can increase various possible options for solving various problems (Bilgin, 2009), students, where learning, and the questions given by teachers in the process of teaching and learning must emphasize aspects of higher-order thinking skills, namely cognitive flexibility abilities.

In this study what is meant by students' cognitive flexibility towards mathematics is the ability of various alternative choices to their ability to solve problems so that they can achieve success in learning achievement in mathematics. Furthermore, someone who can see problems from various points of view, has various ways of solving mathematical problems, has self-efficacy. The indicators of cognitive flexibility that are considered include aspects of: providing various kinds of inventions using numerous approaches and tactics in relation to an image, a story, or a problem. This supports the idea that mental flexibility is crucial for solving mathematical issues (Al-Zoubi, 2020; Boonen et al., 2016; Bullot, 2009) because a lot of content material makes educators generally prioritize other aspects such as understanding concepts, so that in the process when solving mathematical problems, many students are still based on formulas, and step by step methods from guidebooks (Alzubi et al., 2022). However, research related to cognitive flexibility in solving math problems still needs to be studied more deeply and has not yet been focused on seventh grade students at junior high school. Therefore, this study tries to examine more deeply related to students' ability to adapt their thinking when addressing mathematical problems based on social arithmetic occurrences that occur in junior high school class VII. Accordingly, this study seeks to ascertain students' levels of cognitive flexibility when it comes to solving mathematical issues.

Cognitive Flexibility

Cognitive adaptability is the capacity to think followed by appropriate actions and in accordance with the situation at hand,

even though the situation changes suddenly (Silver et al., 2004). An individual who has cognitive flexibility will have various alternative choices when facing certain situations or problems in his life.

Definition of Cognitive Flexibility

Cognitive flexibility is the capacity of a person to coordinate cognitive strategy processes in response to novel and unexpected environmental events (Hillier et al., 2006). Martin further suggests that cognitive flexibility might be seen as the capacity to consider before acting simultaneously, appropriately and adequately in the situation (Yıldız Durak & Atman Uslu, 2022). Then an individual who displays task representations from multiple perspectives will be able to more easily interpret situational changes and be more cognitively flexible (Lowrey & Kim, 2009). Based on the definition of cognitive flexibility, it may be deduced that the type of cognitive flexibility being discussed in this study is the capacity of students to think followed by appropriate actions and in accordance with the problem-solving questions that are solved, even though the questions are different from before.

Aspects of Cognitive Flexibility

Aspects of cognitive flexibility include cognitive variety, cognitive novelty and change in cognitive framing, meaning that when students possess the capacity for flexible thought (cognitive flexibility), the ability to quickly formulate a variety of challenges (cognitive variety), the capacity to address unique or unexpected concepts (cognitive novelty), and the capacity to alter or reframe their identities (change in cognitive framing) (Crosbie et al., 2009). From the description it includes novelty and elaboration in thinking (cognitive originality and elaboration cognitive) so that these components are considered the same. As for the aspects of cognitive flexibility (Chen et al., 2019) that is: (a) Get used to having an open mind; (b) Usually have many ideas and ideas about something; (c) Accustomed to changing the point of view or individual thinking when getting new information; and (d) Accustomed to using various ways of solving problems to solve the same problem

In this study the aspects of cognitive flexibility used are (a) Give different perspectives on a picture, tale, or issue; (b) Utilizing a range of techniques and methods to solve problems.

METHOD

Research Design

This study uses a phenomenological design with a qualitative approach (Creswell, 2015; Darmadi, 2011; Drew et al., 2017) to describe the experience of students related to an event (Creswell, 2015). Participants consisted of students whose answers and experiences were examined, while the phenomenon studied was mathematical problem-solving abilities of kids' cognitive flexibility. There are 3 stages of the phenomenological approach used in this study, namely intuitive, analyzing, and describing. The following is shown in Figure 1 (Sugiyono, 2013).

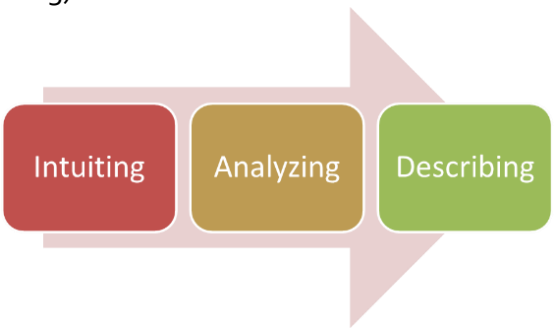


Figure 1. Stages of phenomenological research

Sample and Data Collection

The research sample consisted of 15 grade VII junior high school students in North Sumatra Province, Indonesia, aged 12-13 years. The 15 students consisted of 6 boys and 7 girls. Related to how they learn, how the books and teaching materials they use, and who teaches can be evident in the study's findings. To gather data on students' cognitive flexibility abilities in solving mathematical issues, examinations of mathematical problem-solving based on cognitive flexibility ability indicators are utilized.

This study has a formulation of the level of cognitive flexibility ability formulated by the researchers themselves. The clarification of students' cognitive flexibility level formulated by the researchers themselves consisted of five levels, namely, TKCF 4 (Very Flexible), TKCF 3 (Flexible), TKCF 2 (Quite Flexible), TKCF 1 (Less Flexible), and TKCF 0 (Not Flexible). Guidelines for the level of cognitive flexibility ability formulated by the researchers themselves as shown in table 1 below.

Table 1. Cognitive Flexibility Ability Test Level Guidelines

Score	Level	Category
$20 \leq N < 25$	Level 4	Very Flexible
$15 \leq N < 20$	Level 3	Flexible
$10 \leq N < 15$	Level 2	Quite Flexible
$5 \leq N < 10$	Level 1	Less Flexible
$0 \leq N < 5$	Level 0	Not Flexible

Note: N = total TKCF score

In addition, interviews were also used to clarify students' cognitive flexibility abilities. Interviews were conducted with 15 participants, each once at a different time. The interviews conducted aimed to verify and find out how far students understand social artmatics material, and how students can solve the questions given based on tests lacking cognitive flexibility when tackling mathematical issues that have already been addressed by other students. Goal-setting and student communication were used to collect data and teachers without forcing them to respond and promising to keep their identities confidential. As a result, students are more willing to answer tests and questions given (Darmadi, 2011).

Analyzing of Data

Data were analyzed in this study using triangulation, namely checking data or sources from various methods or times. In addition, this study uses triangulation of data sources from different students to strengthen credibility and confirmability (Creswell, 2015).

Qualitative research is declared valid if it has a level of credibility, transferability, dependability and confirmability (Creswell, 2015). The credibility test, also known as a test of trust in the research data presented by the researcher, entails extending observations, improving research accuracy, conducting triangulation, i.e., triangulation of sources, triangulation of data collection techniques, and time, so that credibility in this study includes these factors. The degree of accuracy or applicability of research findings to the population from which the sample was drawn is indicated by transferability, an external validity in this study. Accordingly, transferability in this study entails making research reports as detailed, clear, systematic, and reliable as possible. Transferability is the process by which qualitative researchers show that their findings are applicable to other contexts (Prabowo et al., 2022). Every math instructor in Indonesia will be required to enhance pupils' abilities to solve mathematical issues, particularly their cognitive flexibility. In this study, it was discovered that students' capacity to exercise cognitive flexibility varied depending on their individual features. This study has im-

portant implications for how educators and researchers can approach teaching and learning in the future, particularly in schools, to improve kids' cognitive math problem-solving abilities. Nevertheless, other topics besides social arithmetic can be explored to increase our understanding of cognitive flexibility. Future study is also intended to create learning models or techniques to improve cognitive flexibility in addressing mathematical problems. The transferability procedure operates in this situation. Dependability in a study is achieved by completing an audit of the complete research process with a supervisor to be able to explain all data activities to analysis and decision making. Dependability in a study is achieved when other people can reproduce or replicate the research process. Last but not least, dependability is the extent to which a study can be replicated by additional researchers with the results remaining consistent (Prabowo et al., 2022). The cognitive flexibility skills of pupils in solving arithmetic problems will be explained by this study. According to the findings of this study, researchers and educational professionals should attempt to create classroom instruction in the future, especially in schools, to help students develop their cognitive flexibility skills when solving mathematical issues. Nevertheless, additional subjects besides social arithmetic can be used to study cognitive flexibility for future research. Future study is also intended to create learning models or techniques to improve cognitive flexibility in addressing mathematical problems. The findings of this study (in the form of an overview of junior high school students' cognitive flexibility in solving math problems on social arithmetic material) were also discussed with experts not affiliated with the researchers. The dependency concept has been applied in this instance and in this investigation. Finally, the confirmability or objectivity test for research is comparable to the dependability test in that testing can be done concurrently; consequently, confirmability in this study includes testing the research results obtained in relation to the procedures that have been carried out to meet confirmability standards.

Therefore, this study retrieved data obtained from the research location at one of the Public Middle Schools in Padangsidimpuan City to obtain validity, so the efforts when all the data had been gathered, the researcher took the decision to carry out the procedure of verifying the accuracy of the data (trust) and going back to the research frequently. at the research site to verify the accuracy of information on students' capacities for cognitive flexibility when completing mathematical tasks.

RESULTS AND DISCUSSION

Results

To find out more about cognitive flexibility abilities and researchers assessed cognitive flexibility abilities in pupils at one of the Padangsidimpuan's State Middle Schools. Besides that, the researchers also discussed with the school principal, class VII mathematics teacher regarding the application of the curriculum, learning methods and the conditions of the students who would be participants in this study. Some of the information obtained among them: (a) In terms of curriculum; This State Junior High School implements the 2013 curriculum with the Semester Credit System (SKS) learning starting from the 2013/2014 academic year, with this system giving students the freedom to study, and developing according to students' abilities naturally, as for the total credit load that students must take is 228JP. Each semester the maximum

number of credits that can be taken is 38 JP, while subjects are grouped into two types, group A subjects cover a minimum of 180 JP and group B subjects at least 48 JP. The number of math teachers in class VII is 5 people. In terms of learning methods, the learning methods used by the teacher vary according to the topic of the material to be discussed; (b) The material taught in mathematics includes a total load per semester of 5 JP; (c) The age of class VII students at this SMPN ranges from 12-13 years, the same as other schools

After discussions with school principals and mathematics teachers, researchers conducted observations, tested cognitive flexibility abilities of participants consisting of 15 class VII participants, with the aim of capturing information about participants' cognitive flexibility abilities in solving mathematical problems on social arithmetic material. As for indicators of cognitive flexibility ability can be seen from the 3 essay test questions which are intended to determine the extent to which students understand social arithmetic material, and how students can solve the given questions. Here are 3 questions used in this study:

(1) The percentage of profit is obtained from the amount of profit divided by the purchase price multiplied by 100%. Consider the following example!
I bought shoes for IDR 90,000. To get a 30% profit, I must sell it for IDR 117,000. Make more than one other problem that results in a profit percentage!

(2) The following diagram shows the buying and selling prices of fruit at a shop in 3 months

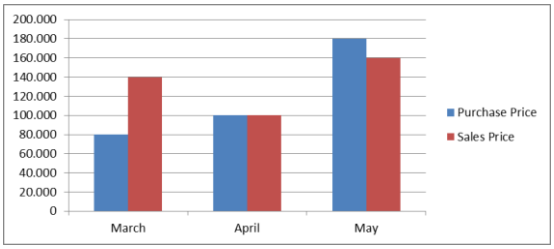


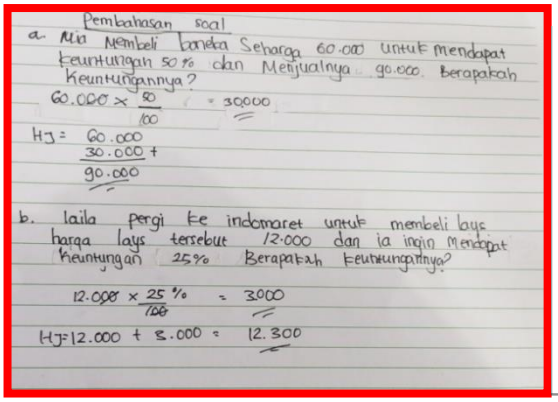
Figure 2. Picture of the diagram for the cognitive flexibility ability test number 2

Based on the diagram above, make 3 different questions and their answers relating to the selling price and buying price.

(3) The cost of sending 5 cans of Kong Guan Cake is IDR 45,000. It is known that the cost of shipping goods is IDR 9,000 per kilogram.
On each can written net weight (net) 900 grams. Use more than one method to determine the maximum weight of one can that is used to pack the cake!

Based on the diagram above, make 3 different questions and their answers relating to the selling price and the buying price.

As for one of the questions about the ability of cognitive flexibility in solving mathematical problems as follows. The profit percentage is obtained from the profit divided by the purchase price multiplied by 100%. Consider the following example! "I bought shoes for IDR 90,000. To get 30% profit, I must sell it for IDR 117,000." Make more than one other problem that results in a 30% win-


Pembahasan soal

a. Mia membeli boneka seharga 60.000 untuk mendapat keuntungan 50% dan menjualnya 90.000. Berapakah keuntungannya?

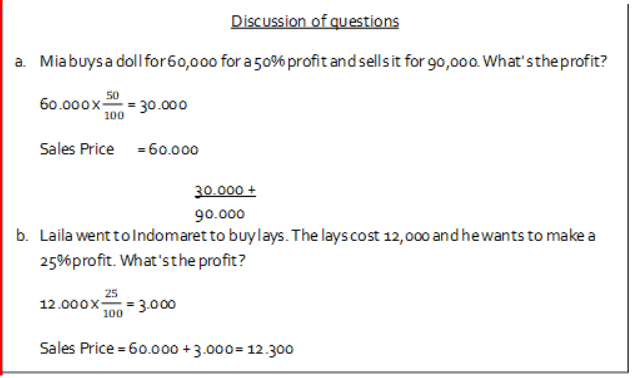
$60.000 \times \frac{50}{100} = 30000$

HJ = 60.000 + 30.000 = 90.000

b. laila pergi ke indomaret untuk membeli lays harga lays tersebut 12.000 dan ia ingin mendapat keuntungan 25% Berapakah keuntungannya?

$12.000 \times \frac{25\%}{100} = 3000$

HJ = 12.000 + 3.000 = 12.300


Discussion of questions

a. Mia buys a doll for 60,000 for a 50% profit and sells it for 90,000. What's the profit?

$60.000 \times \frac{50}{100} = 30.000$

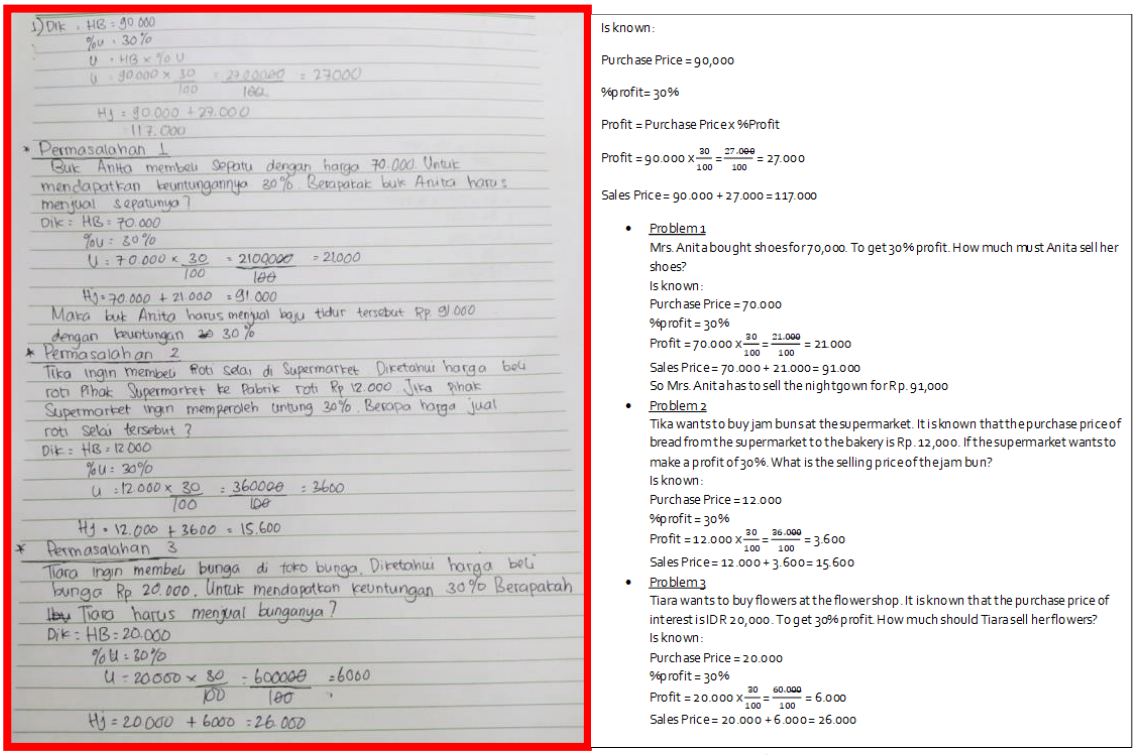
Sales Price = 60.000 + 30.000 = 90.000

b. Laila went to Indomaret to buy lays. The lays cost 12,000 and he wants to make a 25% profit. What's the profit?

$12.000 \times \frac{25}{100} = 3.000$

Sales Price = 60.000 + 3.000 = 12.300

Figure 3. Alternative answers to participants' cognitive flexibility abilities 2



Is known:

Purchase Price = 90,000

%profit= 30%

Profit = Purchase Price x %Profit

Profit = 90.000 x $\frac{30}{100} = \frac{27.000}{100}$ = 27.000

Sales Price = 90.000 + 27.000 = 117.000

- Problem 1
  Mrs. Anita bought shoes for 70,000. To get 30% profit. How much must Anita sell her shoes?
  Is known:
  Purchase Price = 70.000
  %profit = 30%
  Profit = 70.000 x $\frac{30}{100} = \frac{21.000}{100}$ = 21.000
  Sales Price = 70.000 + 21.000 = 91.000
  So Mrs. Anita has to sell the nightgown for Rp. 91,000
- Problem 2
  Tika wants to buy jam buns at the supermarket. It is known that the purchase price of bread from the supermarket to the bakery is Rp. 12,000. If the supermarket wants to make a profit of 30%. What is the selling price of the jam bun?
  Is known:
  Purchase Price = 12.000
  %profit = 30%
  Profit = 12.000 x $\frac{30}{100} = \frac{36.000}{100}$ = 3.600
  Sales Price = 12.000 + 3.600 = 15.600
- Problem 3
  Tiara wants to buy flowers at the flower shop. It is known that the purchase price of interest is IDR 20,000. To get 30% profit. How much should Tiara sell her flowers?
  Is known:
  Purchase Price = 20.000
  %profit = 30%
  Profit = 20.000 x $\frac{30}{100} = \frac{60.000}{100}$ = 6.000
  Sales Price = 20.000 + 6.000 = 26.000

Figure 4. Alternative answers to participants' cognitive flexibility abilities 1

ning percentage! From the questions asked to the students below, it can be seen the alternative answers of the participants (*See Figure 3 and Figure 4*).

The indicators used in cognitive flexibility skills in solving mathematical problems are: 1) giving several interpretations of a graphic, narrative, or mathematical problem; and 2) utilizing numerous mathematical problem-solving techniques. From the answers of the participants it can be seen that, participant 1 has been able to optimally use his own way and the method of solving problems that are appropriate to the problems asked for, while participant 2 has not optimally put forward cognitive flexibility ideas, this can be seen from the participants' answers that are not appropriate in giving examples of problems which was requested with a 30% advantage, besides that, the participants also did not provide answers with correct solutions to the given social arithmetic questions, so that aspects of mathematical cognitive flexibility abilities did not appear in this case.

As for what follows below, an analysis of the results of written scores obtained from 15 participants on social arithmetic questions will be described. The following is an analysis of the results of the answers written on the cognitive flexibility ability in solving mathematical problems as shown in Table 2.

Table 2. Analysis of Written Test Results Score Answers Cognitive Flexibility Ability in Solving Mathematical Problems Overall

Participants	Skor Question Number			Average	Level
	1	2	3		
1	19	18	20	19.00	Level 3
2	6	7	10	7.67	Level 1
3	8	9	10	9.00	Level 1
4	11	12	15	12.67	Level 2
5	17	19	18	18.00	Level 3
6	12	14	11	12.33	Level 2
7	19	16	17	17.33	Level 3
8	13	12	15	13.33	Level 2
9	6	7	9	7.33	Level 1
10	14	12	13	13.00	Level 2
11	19	18	19	18.67	Level 3
12	6	7	9	7.33	Level 1
13	11	14	12	12.33	Level 2
14	13	15	12	13.33	Level 2
15	18	16	20	18	Level 3

Discussion

In general, R1, R5, R7, R11, R15 (as many as 5 participants) were able to understand the meaning of the questions given, it can be seen from the written results that 5 participants were able to provide 1 answer with 1 approach but there was still an answer to one of the solutions that was not thorough. This shows that 5 Participants received a score of 3. The score obtained by S1 on the flexibility indicator criteria was 3, because 5 Participants were able to provide correct answers and reasons with 3 different approaches, namely the approach for example 2, example 3, and example 4 So that 5 Participants at this level have good flexibility, seen from their capacity to use one method to tackle a problem, then switch to another According to the written results, the five participants were able to answer the problem in one way before using another method. It's just that some of the obstacles experienced by the 5 participants, one of which was a lack of accuracy, so that the answers were not in accordance with the questions and only 1 question was correct. Based on the written results, it shows that 5 participants showed an indicator of flexibility in answering questions. Based on several written test results and interview results, 5 participants were able to demonstrate cognitive flexibility abilities with indicators of flexibility however there were, so that 5 participants were included in cognitive flexibility ability level 3 (flexible).

In general, R4, R6, R8, R10, R13, R14 (as many as 6 participants) were able to provide 2 correct answers and reasons with two different approaches, but in other answers there were still errors in giving answers, so 6 Participants got a score of 2 on the flexibility indicator criteria. Based on this, it shows that the 6 participants at this level have sufficient flexibility, seen from their ability to solve problems in one way and then use another way, but in other questions there are still errors in answering questions. Based on some of the written test results and interview results, 6 participants were sufficiently able to demonstrate cognitive flexibility abilities with flexibility indicators, so that 6 participants were included in cognitive flexibility ability level 2 (quite flexible).

Based on the results written in general R2, R3, R9, R12 (totaling 4 participants), it appears that 4 participants can show indicators of flexibility but still must be developed, because 4 participants get 1 score on the criteria for flexibility indicators. 4 Participants provide answers in a way that is commonly used and still in general (like the alternative answers that have been provided or has the same approach as other subjects). Based on the written results and interview results, it was shown that 4 participants had not been able to solve problems with various interpretations or answers correctly so that 4 participants at this level had not shown any indicators of flexibility, so that 4 participants were included in cognitive flexibility ability level 1 (less flexible).

From the research results above, according to observations made, namely the importance of being taught cognitive skills in teaching and learning, so that it will affect students' ability to think. There are several reasons for the need for cognitive abilities in learning mathematics, with an emphasis on cognitive flexibility abilities, among them are as follows: (1) mathematics is a complex and broad knowledge so that it is not sufficiently taught by rote, (2) students have the potential to cognitive flexibility and self-efficacy in all matters, including mathematics which is the science of human activity, (3) when addressing issues, kids

might come up with their own solutions, thereby satisfying themselves (triggering internal motivation), (4) educators can see original contributions, and amazing ideas from students, so as to provide opportunities to share ideas, and learn from each other, (5) improve students' abilities and mathematical abilities, (6) provide experience that find something that is a variety of alternatives requires process, deep and flexible thinking, persistence, and never giving up, such as making a variety alternative problems according to conditions, (7) real everyday life requires mathematics, while everyday problems are not routine, so they require cognitive flexibility in solving them.

In the classroom, students who have different backgrounds and abilities will also have different cognitive abilities. So that students' cognitive flexibility abilities in solving and posing problems can be grouped into certain levels. Certain levels include those that are less flexible, quite flexible, and flexible, where these levels are obtained from observations of the problem-solving skills given to students. This is in line with the statement that cognitive flexibility abilities have various levels as they have various levels of intelligence (Roy & Dugal, 1998). Furthermore, the statement states that when an individual performs a complex task, his behavior needs to be adapted to the situation and environmental conditions in which he is located. However, when the tasks being carried out develop or become more complex, conditions and situations change (Canas, 2006). To be able to adapt to changing conditions, an individual needs to be flexible.

Martin stated that before someone can show flexible behavior, that person must be cognitively flexible first (Martin M. M., 1995). To become cognitively flexible, first, an individual undergoes a process of social cognition in which the individual becomes aware of the choices and alternatives that exist. Second, an individual needs to have the will to be flexible. Because even though an individual realizes that the individual has alternative choices to deal with a particular situation, the individual must also have the motivation or willingness to realize the choice into a behavior that is suitable for use in that situation. Finally, an individual who has cognitive flexibility will believe in his own ability to behave effectively. When someone is aware of alternative choices and has the will or motivation to realize his choice, that person also needs to believe that his choice is beneficial to bring up the desired behavior (Martin M. M., 1995).

In addition, Canas describes two factors that support a person's cognitive flexibility. The first is attention or concern. In detecting that the situation has changed, a person needs higher attention to access the situation and plan the actions to be taken as well as control the automatic response that usually appears. Second, cognitive flexibility refers to the experiences one has gained in dealing with similar tasks or situations (Canas, 2006). The two explanations complement each other because to be cognitively flexible an individual needs both to cope with and to interpret new situations to restructure their knowledge to adapt behavioral strategies accordingly (Canas, 2006).

From the description above, it can be concluded that someone who is more cognitively flexible can be more effective in behaving and completing tasks in his life even in constantly changing situations (Canas, 2006). That is, cognitive flexibility will help an individual to be able to adapt and be able to quickly change the way he thinks. (Canas, 2006) also revealed that an individual who has high cognitive flexibility will be able to have

the ability to generate ideas that are then used to solve problems, to locate and employ several techniques to deal with problems, and to view problems from various angles. On the other hand, a person who lacks cognitive flexibility, the individual will behave ineffectively in dealing with situational demands and often experience errors in completing tasks in his life. Besides that, an individual who has high cognitive flexibility will be more able to adapt to stressful situations. Meanwhile, if an individual has low cognitive flexibility, he will tend to be rigid and less able to deal with stressful situations (Dennis, 2010).

Cognitive flexibility is an embodiment of higher-order thinking processes, so cognitive flexibility also has levels or groups. Exploring the level/group of students' cognitive flexibility abilities will make it easier for us to assess them validly, whether they belong to a certain level/level or not. Then work on how he reaches a higher level. To achieve all of this requires continuous efforts of educators in the learning process.

Implication of Research

The implication in the research is that future researchers and education practitioners, especially in schools, can try to design learning in schools so that students' capacity for cognitive flexibility when solving mathematical problems can improve. Even so, cognitive flexibility can be studied in other materials besides social arithmetic for further research. It is also hoped that future researchers can develop learning models or methods to improve cognitive flexibility in solving mathematical problems. Apart from this the teacher can teach students one of three things to train so that students become more flexible in cognition when working on mathematical problem-solving problems, namely: (a) Teach and train students in different ways of solving mathematical problems; (b) Train students to do something to pursue new challenges so that students find new ways of solving mathematical problems; (c) Train students to meet new people outside the student class when working on mathematical problem solving problems so that it is that students will become more flexible.

Limitation

The limitations in this study include the time the research was not optimal, then the limitations of the number of participants and research subjects. This research still needs to be carried out in more depth for the researchers themselves and future researchers related to students' cognitive flexibility abilities in solving mathematical problems.

CONCLUSION

It can be determined from the study and discussion that was conducted that the 15 participants were able to demonstrate cognitive flexibility abilities and represented different levels of cognitive flexibility abilities in showing indicators of cognitive flexibility abilities. A description of the level of cognitive flexibility ability in solving mathematical problems with a phenomenological research design on social arithmetic material, namely the first of 5 participants, at level 3 or flexible cognitive flexibility ability. Subjects were able to bring up both indicators of cognitive flexibility abilities well, namely giving various interpretations of a picture, story, or mathematical problem and using various strategies in solving a problem, but they were still not thorough in one of the questions. Second, there were 6 participants, subjects at the level of cognitive flexibility 2 or flexible abilities were able

to bring up indicators of cognitive flexibility abilities, namely using a variety of mathematical problem-solving strategies that were quite good when solving a problem. Third, there were 4 participants, subjects at cognitive flexibility level 1 or less flexible, only able to bring up a little indicator of cognitive flexibility ability, namely providing various interpretations of a picture, story, or mathematical problem so that it still needs to be developed.

REFERENCES

Al-Zoubi, E. M. (2020). Quality of Life and Its Relationship with Cognitive Flexibility among Higher Education Students. *Journal of Educational and Social Research*, *10*(4), 156-167. https://doi.org/10.36941/jesr-2020-0075

Alzubi, E. M., Attiat, M. M., & Al-Adamat, O. A. (2022). Systemic intelligence predictors of cognitive flexibility and cognitive holding power among university students. *Cypriot Journal of Educational Sciences*, *17*(2), 491–505. https://doi.org/10.18844/CJES.V17I2.6835

Arcavi, A., & Friedlander, A. (2007). Curriculum developers and problem solving: the case of Israeli elementary school projects. *ZDM 2007 39:5*, *39*(5), 355–364. https://doi.org/10.1007/S11858-007-0050-3

Arifin, S., Zulkardi, Putri, R. I. I., & Hartono, Y. (2021). On creativity through mathematization in solving non-routine problems. *Journal on Mathematics Education*, *12*(2), 313–330. https://doi.org/10.22342/JME.12.2.13885.313-330

Astutiani, R., & Isnarto, I. (2021). Problem Solving Ability Considered by Self Confidence in Digital Media Assisted Online Learning. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *12*(2), 323–334. https://doi.org/10.15294/KREANO.V12I2.30828

Bilgic, B. S., Sonmez, A. O., & Erdogan, A. (2021). Cognitive emotion regulation strategies and cognitive flexibility levels in high school students subjected to peer bullying. *Haseki Tip Bulteni*, *59*(5), 393–399. https://doi.org/10.4274/HASEKI.GALENOS.2021.7791

Bilgin, M. (2009). Developing a cognitive flexibility scale: Validity and reliability studies. *Social Behavior and Personality*, *37*(3), 343–354. https://doi.org/10.2224/SBP.2009.37.3.343

Boonen, A. J. H., Reed, H. C., Schoonenboom, J., & Jolles, J. (2016). It's not a math lesson - we're learning to draw! Teachers' use of visual representations in instructing word problem solving in sixth grade of elementary school. *Frontline Learning Research*, *4*(5), 34–61. https://doi.org/10.14786/FLR.V4I5.245

Bosch, P., Herrera, M., López, J., & Maldonado, S. (2018). Mining EEG with SVM for Understanding Cognitive Underpinnings of Math Problem Solving Strategies. *Behavioural Neurology*, *2018*, 15 pages. https://doi.org/10.1155/2018/4638903

Bullot, N. J. (2009). Toward a theory of the empirical tracking of individuals: Cognitive flexibility and the functions of attention in integrated tracking. *Philosophical Psychology*, *22*(3), 353–387. https://doi.org/10.1080/09515080902969006

Cambaz, H. Z., & Ünal, G. (2021). Does Student's Cognitive Flexibility Decrease During Pandemic? A New Approach to Measure Cognitive Flexibility. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, *9*(1), 13–22. https://doi.org/10.23947/2334-8496-2021-9-1-13-22

Chen, X., He, J., & Fan, X. (2019). Relationships between openness to experience, cognitive flexibility, self-esteem, and creativity among bilingual college students in the U.S. *International Journal of Bilingual Education and Bilingualism*, *25*(1), 342–354. https://doi.org/10.1080/13670050.2019.1688247

Chevalier, M., Giang, C., Piatti, A., & Mondada, F. (2020). Fostering computational thinking through educational robotics: a model for creative computational problem solving. *International Journal of STEM Education*, *7*(1), 1–18. https://doi.org/10.1186/S40594-020-00238-Z/FIGURES/9

Chung, S. H., Su, Y. F., & Su, S. W. (2012). The impact of cognitive flexibility on resistance to organizational change. *Social Behavior and Personality*, *40*(5), 735–746. https://doi.org/10.2224/SBP.2012.40.5.735

Creswell, J. (2015). *Educational research planning, implementation, and evaluation of qualitative and quantitative research*. Yogyakarta: Pustaka Belajar.

Crosbie, S., Holm, A., & Dodd, B. (2009). Cognitive flexibility in children with and without speech disorder. *Child Language Teaching and Therapy*, *25*(2), 250–270. https://doi.org/10.1177/0265659009102990

Damirchi, E. S., Pireinaladin, S., Akbari, T., & Dargahi, S. (2020). The prediction of the student's tendency to computer games based on the brain-behavioral functions, cognitive

flexibility and sensation seeking. *Archives of Psychiatry and Psychotherapy*, *1*, 70–76. https://doi.org/10.12740/APP/109309

Darmadi, H. (2011). *Educational research methods*. Alfabeta.

Demirtaş, A. S. (2020). Optimism and happiness in undergraduate students: Cognitive flexibility and adjustment to university life as mediators. *Anales de Psicología / Annals of Psychology*, *36*(2), 320–329. https://doi.org/10.6018/ANALESPS.381181

Depdiknas. (2006). *Standar Isi Mata Pelajaran Matematika Tingkat Sekolah Dasar dan Menengah (Content Standards for Elementary and Middle School Mathematics Subjects)*. Depdiknas.

Drew, C. J., Hardman, M. L., & Hosp, J. L. (2017). *Educational research: Designing and carrying out research in the field of education*. Permata Puri Media.

Ebersbach, M., & Hagedorn, H. (2011). The Role of Cognitive Flexibility in the Spatial Representation of Children's Drawings. *Journal of Cognition and Development*, *12*(1), 32–55. https://doi.org/10.1080/15248372.2011.539526

Fajri, H. M., Misdalina, M., & Kesumawati, N. (2021). Mathematical Problem Solving Ability of SMP 1 Kelekar Students Analized Based on Student Learning Motivation. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *12*(1), 85–96. https://doi.org/10.15294/KREANO.V12I1.28337

Gajewski, P. D., Wild-Wall, N., Schapkin, S. A., Erdmann, U., Freude, G., & Falkenstein, M. (2010). Effects of aging and job demands on cognitive flexibility assessed by task switching. *Biological Psychology*, *85*(2), 187–199. https://doi.org/10.1016/J.BIOPSYCHO.2010.06.009

Gao, T., Zhao, J., Dou, K., Wang, Y., Li, X., & Harrison, S. E. (2018). Impact of cognitive flexibility on rapid reading skills training outcomes for primary school students in China. *School Psychology International*, *39*(3), 273–290. https://doi.org/10.1177/0143034318773787

Gökçen, B., Laçin, D., & Yalçin, İ. (2019). Predictive Roles of Self-Efficacy and Coping Strategies in Cognitive Flexibility among University Students. *Hacettepe University Journal of Education*, *34*(2), 358–371. https://doi.org/10.16986/HUJE.2018037424

Grežo, M., & Sarmány-Schuller, I. (2018). Do Emotions Matter? The Relationship Between Math Anxiety, Trait Anxiety, and Problem Solving Ability. *Studia Psychologica*, *60*(4), 226–244. https://doi.org/10.21909/sp.2018.04.764

Gruber, A. J., Calhoon, G. G., Shusterman, I., Schoenbaum, G., Roesch, M. R., & O'Donnell, P. (2010). More Is Less: A Disinhibited Prefrontal Cortex Impairs Cognitive Flexibility. *Journal of Neuroscience*, *30*(50), 17102–17110. https://doi.org/10.1523/JNEUROSCI.4623-10.2010

Han, D. H., Park, H. W., Kee, B. S., Na, C., Na, D. H. E., & Zaichkowsky, L. (2011). Performance Enhancement with Low Stress and Anxiety Modulated by Cognitive Flexibility. *Psychiatry Investigation*, *8*(3), 221–226. https://doi.org/10.4306/PI.2011.8.3.221

He, Z., Li, M., Liu, C., & Ma, X. (2022). Common Predictive Factors of Social Media Addiction and Eating Disorder Symptoms in Female College Students: State Anxiety and the Mediating Role of Cognitive Flexibility/Sustained Attention. *Frontiers in Psychology*, *12*, 6182. https://doi.org/10.3389/FPSYG.2021.647126

Hillier, A., Alexander, J. K., & Beversdorf, D. Q. (2006). The effect of auditory stressors on cognitive flexibility. *Neurocase*, *12*(4), 228–231. https://doi.org/10.1080/13554790600878887

Hong, J. C., Hwang, M. Y., Szeto, E., Tai, K. H., & Tsai, C. R. (2021). Undergraduate Science Students' Scientist–Practitioner Gap: the Role of Epistemic Curiosity and Cognitive Flexibility. *International Journal of Science and Mathematics Education*, *19*(5), 899–913. https://doi.org/10.1007/S10763-020-10096-4/TABLES/1

Jiatong, W., Murad, M., Li, C., Gill, S. A., & Ashraf, S. F. (2021a). Linking cognitive flexibility to entrepreneurial alertness and entrepreneurial intention among medical students with the moderating role of entrepreneurial self-efficacy: A second-order moderated mediation model. *PLOS ONE*, *16*(9), e0256420. https://doi.org/10.1371/JOURNAL.PONE.0256420

Jiatong, W., Murad, M., Li, C., Gill, S. A., & Ashraf, S. F. (2021b). Correction: Linking cognitive flexibility to entrepreneurial alertness and entrepreneurial intention among medical students with the moderating role of entrepreneurial self-efficacy: A second-order moderated mediation model. *PLOS ONE*, *16*(10), e0259491. https://doi.org/10.1371/JOURNAL.PONE.0259491

Jonassen, D. H. (1997). Instructional design models for well-structured and III-structured problem-solving learning outcomes. *Educational Technology Research and Development*, *45*(1), 65–94. https://doi.org/10.1007/BF02299613

Jones, R. A., Studies, R., & Spiro, R. (n.d.). Imagined Conversations: The Relevance of Hyper-

text, Pragmatism, and Cognitive Flexibility Theory to the Interpretation of "Classic Texts" in Intellectual History. in *Proceedings of the ACM Conference on Hypertext* (pp. 141-148). https://doi.org/10.1145/168466

Kingsdorf, S., & Krawec, J. (2016). Assessing a multi-component math intervention within a cognitive-behavioral framework on the word problem-solving responses of a diverse group of third graders. *Cogent education, 3*(1), 1160638. https://doi.org/10.1080/2331186X.2016.1160638

Lloyd, J., Bond, F. W., & Flaxman, P. E. (2013). The value of psychological flexibility: Examining psychological mechanisms underpinning a cognitive behavioural therapy intervention for burnout. *Work & Stress An International Journal of Work, Health & Organisations*, *27*(2), 181–199. https://doi.org/10.1080/02678373.2013.782157

Lowrey, W., & Kim, K. S. (2009). Online News Media and Advanced Learning: A Test of Cognitive Flexibility Theory. *Journal of Broadcasting & Electronic Media*, *53*(4), 547–566. https://doi.org/10.1080/08838150903323388

Martin, M. M., & Anderson, C. M. (2009). The cognitive flexibility scale: Three validity studies. *Communication Reports*, *21*(1), 1–9. https://doi.org/10.1080/08934219809367680

Martin, M. M., Staggers, S. M., & Anderson, C. M. (2011). The Relationships Between Cognitive Flexibility with Dogmatism, Intellectual Flexibility, Preference for Consistency, and Self-Compassion. *Communication Research Reports*, *28*(3), 275–280. https://doi.org/10.1080/08824096.2011.587555

Martinez, J. K., & Dong, S. (2020). An Investigation of Multicultural Counseling Competence Development among Graduate-Level Counseling Students through Mindfulness, Cognitive Complexity, and Cognitive Flexibility. *International Journal for the Advancement of Counselling*, *42*(3), 292–306. https://doi.org/10.1007/S10447-020-09400-2

Marzecová, A., Bukowski, M., Correa, Á., Boros, M., Lupiáñez, J., & Wodniecka, Z. (2013). Tracing the bilingual advantage in cognitive control: The role of flexibility in temporal preparation and category switching. *Journal of Cognitive Psychology*, *25*(5), 586–604. https://doi.org/10.1080/20445911.2013.809348

Milla-Cano, C., & Gatica-Ferrero, S. (2020). Memoria de trabajo y flexibilidad cognitiva en niños típicos y con diagnóstico de TDAH. *Avances En Psicología Latinoamericana* , *38*(3), 1–15. https://doi.org/10.12804/REVISTAS.UROSARIO.EDU.CO/APL/A.7743

Muyan-Yılık, M., & Demir, A. (2020). A Pathway Towards Subjective Well-Being for Turkish University Students: The Roles of Dispositional Hope, Cognitive Flexibility, and Coping Strategies. *Journal of Happiness Studies*, *21*(6), 1945–1963. https://doi.org/10.1007/s00440-002-0236-0

NCTM. (2000). *Principles and standards for school mathematics*.

Prabowo, A., Suryadi, D., Dasari, D., Juandi, D., & Junaedi, I. (2022). Learning Obstacles in the Making of Lesson Plans by Prospective Mathematics Teacher Students. *Education Research International*, *2022*, 15 pages. https://doi.org/10.1155/2022/2896860

Pratama, L. D., & Setyaningrum, W. (2018). GBL in Math Problem Solving: Is it Effective? *International Journal of Interactive Mobile Technologies (IJIM)*, *12*(6), 101–111. https://doi.org/10.3991/IJIM.V12I6.8658

Renner, K. H., & Beversdorf, D. Q. (2010). Effects of naturalistic stressors on cognitive flexibility and working memory task performance. *Behavior, Cognition and Neuroscience*, *16*(4), 293–300. https://doi.org/10.1080/13554790903463601

Roy, M. H., & Dugal, S. S. (1998). Developing trust: The importance of cognitive flexibility and co-operative contexts. *Management Decision*, *36*(9), 561–567. https://doi.org/10.1108/00251749810239441/

Schoenfeld, A. H. (1985). *Mathematical problem solving*. 409. Academic Press https://doi.org/10.1016/C2013-0-05012-8

Silver, J. A., Hughes, J. D., Bornstein, R. A., & Beversdorf, D. Q. (2004). Effect of anxiolytics on cognitive flexibility in problem solving. *Cognitive and Behavioral Neurology*, *17*(2), 93–97. https://doi.org/10.1097/01.WNN.0000119240.65522.D9

Soewardini, H. M. D., Setiyawan, H., Suhartono, Amin, S. M., & Bon, A. T. Bin. (2019). An information technology-based learning to reduce math anxiety in solving problem. *International Journal of Engineering and Advanced Technology*, *9*(1), 2117–2119. https://doi.org/10.35940/IJEAT.A9670.109119

Spensley, F., & Taylor, J. (1999). The Development of Cognitive Flexibility: Evidence from Children's Drawings. *Human Development*, *42*(6), 300–324. https://doi.org/10.1159/000022639

Sugiyono. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D (Educational research methods quantitative, qualitative and R&D approaches)*. Alfabeta.

Swanson, H. L. (2015). Cognitive strategy interventions improve word problem solving and

working memory in children with math disabilities. *Frontiers in Psychology*, *6*, 1099. https://doi.org/10.3389/FPSYG.2015.01099/BIBTEX

Swanson, H. L., Kong, J., & Petcu, S. D. (2019). Math problem-solving and cognition among emerging bilingual children at risk and not at risk for math difficulties. *Child Neuropsychology A Journal on Normal and Abnormal Development in Childhood and Adolescence*, *26*(4), 489–517. https://doi.org/10.1080/09297049.2019.1674268

Sweller, J. (1988). Cognitive Load During Problem Solving: Effects on Learning. *Cognitive Science*, *12*(2), 257–285. https://doi.org/10.1207/S15516709COG1202_4

Theeboom, T., Beersma, B., & Van Vianen, A. E. M. (2015). The differential effects of solution-focused and problem-focused coaching questions on the affect, attentional control and cognitive flexibility of undergraduate students experiencing study-related stress. *The Journal of Positive Psychology Dedicated to Furthering Research and Promoting Good Practice*, *11*(5), 460–469. https://doi.org/10.1080/17439760.2015.1117126

Utemov, V. V., Ribakova, L. A., Kalugina, O. A., Slepneva, E. V., Zakharova, V. L., Belyalova, A. M., & Platonova, R. I. (2020). Solving Math Problems through the Principles of Scientific Creativity. *Eurasia Journal of Mathematics, Science and Technology Education*, *16*(10), em1887. https://doi.org/10.29333/EJMSTE/8478

von Duyke, K., & Matusov, E. (2015). Flowery math: a case for heterodiscoursia in mathematics problems solving in recognition of students' authorial agency. *Pedagogies: An International Journal*, *11*(1), 1–21. https://doi.org/10.1080/1554480X.2015.1090904

Wang, J., & Jou, M. (2020). The influence of mobile-learning flipped classrooms on the emotional learning and cognitive flexibility of students of different levels of learning achievement. *Interactive Learning Environments*. *28*, 14 pages. https://doi.org/10.1080/10494820.2020.1830806

Wang, R. N., & Chang, Y. C. (2022). Effect of Intrinsic Motivation on Junior High School Students' Creativity: Mediating Role of Cognitive Flexibility. *International Journal of Educational Methodology*, *8*(2), 297–312. https://doi.org/10.12973/IJEM.8.2.297

Wen, W. P., Ismail, N., Ali, M., Osman, S., & Talib, C. A. (2020). Application of Sakamoto math method in solving mathematical word problems for year 5 pupils. *ASM Science Journal*, *13*, 6 pages. https://doi.org/10.32802/ASMSCJ.2020.SM26(2.5)

Yıldız Durak, H., & Atman Uslu, N. (2022). Investigating the effects of SOLO taxonomy with reflective practice on university students' meta-cognitive strategies, problem-solving, cognitive flexibility, spatial anxiety: an embedded mixed-method study on 3D game development. *Interactive Learning Environments*, *30*. https://doi.org/10.1080/10494820.2022.2067187

Zhang, H., Kranzler, H. R., Poling, J., Gruen, J. R., & Gelernter, J. (2009). Cognitive Flexibility is Associated with KIBRA Variant and Modulated by Recent Tobacco Use. *Neuropsychopharmacology*, *34*(12), 2508–2516. https://doi.org/10.1038/npp.2009.80